

1 This is a Continuation of U.S. Patent Application Serial No.
2 09/026,050, filed February 19, 1998, ^{Now is PAT NO. 6061,344} and titled "Method of Addressing
3 Messages and Communications System".--

4
5 In the Claims

6 Please cancel claims 1-38 and replace with the following.

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8 ~~39~~. A method of establishing wireless communications between
9 an interrogator and wireless identification devices, the method comprising
10 utilizing a tree search technique to establish communications, without
11 collision, between the interrogator and individual ones of the multiple
12 wireless identification devices, the method including using a search tree
13 having multiple nodes respectively representing subgroups of the multiple
14 wireless identification devices, the method further comprising, for a node,
15 transmitting a command, using the interrogator, requesting that devices
16 within the subgroup represented by the node respond, determining with
17 the interrogator if a collision occurred in response to the command and,
18 if not, repeating the command at the same node.

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~~40~~. A method in accordance with claim ~~39~~ and further
21 comprising, if a collision occurred in response to the first mentioned
22 command, sending a command at a different node, using the interrogator.
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³⁴¹ A method in accordance with claim ~~39~~ wherein when a subgroup contains both a device that is within communications range of the interrogator, and a device that is not within communications range of the interrogator, the device that is not within communications range of the interrogator does not respond to the command.

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~~42~~ A method in accordance with claim ~~39~~ wherein when a subgroup contains both a device that is within communications range of the interrogator, and a device that is not within communications range of the interrogator, the device that is within communications range of the interrogator responds to the command.

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~~43~~ A method in accordance with claim ~~39~~ wherein a device in a subgroup changes between being within communications range of the interrogator and not being within communications range, over time.

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~~44~~ A method in accordance with claim ~~39~~ wherein the wireless identification device comprises an integrated circuit including a receiver, a modulator, and a microprocessor in communication with the receiver and modulator.

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7-45. A method of addressing messages from an interrogator to a selected one or more of a number of communications devices, the method comprising:

establishing for respective devices unique identification numbers;

causing the devices to select random values, wherein respective devices choose random values independently of random values selected by the other devices;

transmitting a communication, from the interrogator, requesting devices having random values within a first specified group of random values to respond;

receiving the communication at multiple devices, devices receiving the communication respectively determining if the random value chosen by the device falls within the first specified group and, if so, sending a reply to the interrogator; and

determining using the interrogator if a collision occurred between devices that sent a reply and, if so, creating a second specified group smaller than the first specified group; and, if not, again transmitting a communication requesting devices having random values within the first specified group of random values to respond.

1 846. A method of addressing messages from an interrogator to a
2 selected one or more of a number of communications devices in
3 accordance with claim ⁷45 wherein sending a reply to the interrogator
4 comprises transmitting the unique identification number of the device
5 sending the reply.

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7 ⁹47. A method in accordance with claim ⁷45 wherein one of the
8 first and second specified groups contains both a device that is within
9 communications range of the interrogator, and a device that is not within
10 communications range of the interrogator, and wherein the device that
11 is not within communications range of the interrogator does not respond
12 to the interrogator.

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14 ¹⁰48. A method of addressing messages from an interrogator to a
15 selected one or more of a number of communications devices in
16 accordance with claim ⁷45 wherein, after receiving a reply without
17 collision from a device, the interrogator sends a communication
18 individually addressed to that device.
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1 1) 49. A method of addressing messages from a transponder to a
2 selected one or more of a number of communications devices, the
3 method comprising:

4 establishing unique identification numbers for respective devices;

5 causing the devices to select random values, wherein respective
6 devices choose random values independently of random values selected
7 by the other devices;

8 transmitting a communication from the transponder requesting
9 devices having random values within a specified group of a plurality of
10 possible groups of random values to respond, the plurality of possible
11 groups being organized in a binary tree defined by a plurality of nodes
12 at respective levels, the specified group being defined as being at one
13 of the nodes;

14 receiving the communication at multiple devices, devices receiving
15 the communication respectively determining if the random value chosen
16 by the device falls within the specified group and, if so, sending a reply
17 to the transponder; and, if not, not sending a reply; and

18 determining using the transponder if a collision occurred between
19 devices that sent a reply and, if so, creating a new, smaller, specified
20 group by descending in the tree; and, if not, transmitting a
21 communication at the same node.

1 ¹²50. A method of addressing messages from a transponder to a
2 selected one or more of a number of communications devices in
3 accordance with claim ¹¹49 wherein establishing unique identification
4 numbers for respective devices comprises establishing a predetermined
5 number of bits to be used for the unique identification numbers.

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7 ¹³51. A method of addressing messages from a transponder to a
8 selected one or more of a number of communications devices in
9 accordance with claim ¹²50 and further including establishing a
10 predetermined number of bits to be used for the random values.

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12 ¹⁴52. A method of addressing messages from an interrogator to a
13 selected one or more of a number of RFID devices, the method
14 comprising:

15 establishing for respective devices unique identification numbers;

16 causing the devices to select random values, wherein respective
17 devices choose random values independently of random values selected
18 by the other devices;

19 transmitting a command using the interrogator requesting devices
20 having random values within a specified group of a plurality of possible
21 groups of random values to respond, the specified group being equal to
22 or less than the entire set of random values, the plurality of possible
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1 groups being organized in a binary tree defined by a plurality of nodes
2 at respective levels;

3 receiving the command at multiple RFID devices, RFID devices
4 receiving the command respectively determining if their chosen random
5 values fall within the specified group and, only if so, sending a reply to
6 the interrogator, wherein sending a reply to the interrogator comprises
7 transmitting the unique identification number of the device sending the
8 reply;

9 determining using the interrogator if a collision occurred between
10 devices that sent a reply and, if so, creating a new, smaller, specified
11 group using a different level of the tree, the interrogator transmitting a
12 command requesting devices having random values within the new
13 specified group of random values to respond; and, if not, the
14 interrogator re-transmitting a command requesting devices having random
15 values within the first mentioned specified group of random values to
16 respond; and

17 if a reply without collision is received from a device, the
18 interrogator subsequently sending a command individually addressed to
19 that device.
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1 ¹⁵53. A method of addressing messages from an interrogator to a
2 selected one or more of a number of RFID devices in accordance with
3 claim ¹⁴52 wherein the first mentioned specified group contains both a
4 device that is within communications range of the interrogator, and a
5 device that is not within communications range of the interrogator, and
6 wherein the device that is not within communications range of the
7 interrogator does not respond to the transmitting of the command or the
8 re-transmitting of the command.

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10 ¹⁶54. A method of addressing messages from an interrogator to a
11 selected one or more of a number of RFID devices in accordance with
12 claim ¹⁴52 wherein the first mentioned specified group contains both a
13 device that is within communications range of the interrogator, and a
14 device that is not within communications range of the interrogator, and
15 wherein the device that is within communications range of the
16 interrogator responds to the transmitting of the command and the
17 re-transmitting of the command.

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19 ¹⁷55. A method of addressing messages from an interrogator to a
20 selected one or more of a number of RFID devices in accordance with
21 claim ¹⁴52 wherein a device in the first mentioned specified group is
22 capable of changing between being within communications range of the
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interrogator and not being within communications range of the interrogator over time.

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~~56~~. A method of addressing messages from an interrogator to a selected one or more of a number of RFID devices in accordance with claim ¹⁴~~52~~ wherein the devices respectively comprise an integrated circuit including a receiver, a modulator, and a microprocessor in communication with the receiver and modulator.

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~~57~~. A method of addressing messages from an interrogator to a selected one or more of a number of RFID devices in accordance with claim ¹⁴~~52~~ and further comprising, after the interrogator transmits a command requesting devices having random values within the new specified group of random values to respond;

devices receiving the command respectively determining if their chosen random values fall within the new smaller specified group and, if so, sending a reply to the interrogator.

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~~58~~. A method of addressing messages from an interrogator to a selected one or more of a number of RFID devices in accordance with claim ¹⁹~~57~~ and further comprising, after the interrogator transmits a command requesting devices having random values within the new specified group of random values to respond;

1 determining if a collision occurred between devices that sent a
2 reply and, if so, creating a new specified group and repeating the
3 transmitting of the command requesting devices having random values
4 within a specified group of random values to respond using different
5 specified groups until all of the devices capable of communicating with
6 the interrogator are identified.

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59. A communications system comprising an interrogator, and a
7 plurality of wireless identification devices configured to communicate with
8 the interrogator using RF, the interrogator being configured to employ
9 tree searching to attempt to identify individual ones of the multiple
10 wireless identification devices, so as to be able to perform
11 communications without collision between the interrogator and individual
12 ones of the multiple wireless identification devices, the interrogator being
13 configured to follow a search tree, the tree having multiple nodes
14 respectively representing subgroups of the multiple wireless identification
15 devices, the interrogator being configured to transmit a command at a
16 node, requesting that devices within the subgroup represented by the
17 node respond, the interrogator further being configured to determine if
18 a collision occurs in response to the command and, if not, to repeat the
19 command at the same node.
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1 ²²~~60~~. A communications system in accordance with claim ²¹~~59~~
2 wherein the interrogator is configured to send a command at a different
3 node if a collision occurs in response to the first mentioned command.
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5 ²³~~61~~. A communications system in accordance with claim ²¹~~59~~
6 wherein a subgroup contains both a device that is within communications
7 range of the interrogator, and a device that is not within communications
8 range of the interrogator.
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10 ²⁴~~62~~. A communications system in accordance with claim ²¹~~59~~
11 wherein a subgroup contains both a device that is within communications
12 range of the interrogator, and a device that is not within communications
13 range of the interrogator, and wherein the device that is within
14 communications range of the interrogator responds to the command.
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16 ²⁵~~63~~. A communications system in accordance with claim ²¹~~59~~
17 wherein a device in a subgroup is movable relative to the interrogator
18 so as to be capable of changing between being within communications
19 range of the interrogator and not being within communications range.
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64. A communications system in accordance with claim 31
wherein the wireless identification device comprises an integrated circuit
including a receiver, a modulator, and a microprocessor in communication
with the receiver and modulator.

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65. A system comprising:
an interrogator;
a number of communications devices capable of wireless
communications with the interrogator;

means for establishing for respective devices unique identification
numbers respectively having the first predetermined number of bits;

means for causing the devices to select random values, wherein
respective devices choose random values independently of random values
selected by the other devices;

means for causing the interrogator to transmit a command
requesting devices having random values within a specified group of
random values to respond;

means for causing devices receiving the command to determine if
their chosen random values fall within the specified group and, if so, to
send a reply to the interrogator; and

means for causing the interrogator to determine if a collision
occurred between devices that sent a reply and, if so, to create a new,
smaller, specified group; and, if not, transmit a command requesting

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1 devices having random values within the same specified group of random
2 values to respond.

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4 ²⁸₆₆. A system in accordance with claim ²⁷₆₅ wherein sending a
5 reply to the interrogator comprises transmitting the unique identification
6 number of the device sending the reply.

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8 ²⁹₆₇. A system in accordance with claim ²⁷₆₅ wherein a specified
9 group contains both a device that is within communications range of the
10 interrogator, and a device that is not within communications range of the
11 interrogator.

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13 ³⁰₆₈. A system in accordance with claim ²⁷₆₅ wherein the
14 interrogator further includes means for, after receiving a reply without
15 collision from a device, sending a command individually addressed to that
16 device.

3169. A system comprising:

an interrogator configured to communicate to a selected one or more of a number of communications devices; and

a plurality of communications devices; the devices being configured to select random values, wherein respective devices choose random values independently of random values selected by the other devices; the interrogator being configured to transmit a command requesting devices having random values within a specified group of a plurality of possible groups of random values to respond, the specified group being less than the entire set of random values, the plurality of possible groups being organized in a binary tree defined by a plurality of nodes at respective levels, the specified group being defined as being at one of the nodes; devices receiving the command being configured to respectively determine if their chosen random values fall within the specified group and, only if so, send a reply to the interrogator, wherein sending a reply to the interrogator comprises transmitting the unique identification number of the device sending the reply; the interrogator being configured to determine if a collision occurred between devices that sent a reply and, if so, create a new, smaller, specified group using a different level of the tree, the interrogator being configured to transmit a command requesting devices having random values within the new specified group of random values to respond; and, if not, the interrogator being configured to re-transmit a command requesting devices having random

1 values within the first mentioned specified group of random values to
2 respond.

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4 ³²_{30.} A system in accordance with claim ³¹₆₉ wherein the first
5 mentioned specified group contains both a device that is within
6 communications range of the interrogator, and a device that is not within
communications range of the interrogator.

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9 ³³_{71.} A system in accordance with claim ³¹₆₉ wherein a device in
10 the first mentioned specified group is capable of changing between being
11 within communications range of the interrogator and not being within
12 communications range of the interrogator over time.

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14 ³⁴_{72.} A system in accordance with claim ³¹₆₉ wherein the respective
15 devices comprise an integrated circuit including a receiver, a modulator,
16 and a microprocessor in communication with the receiver and modulator.

3573. A system comprising:

an interrogator configured to communicate to a selected one or more of a number of RFID devices;

a plurality of RFID devices, respective devices being configured to store a unique identification number, respective devices being further configured to store a random value;

the interrogator being configured to transmit a command requesting devices having random values within a specified group of a plurality of possible groups of random values to respond, the plurality of possible groups being organized in a binary tree defined by a plurality of nodes at respective levels, the specified group being defined as being at one of the nodes;

devices receiving the command respectively being configured to determine if their chosen random values fall within the specified group and, if so, send a reply to the interrogator; and, if not, not send a reply; and

the interrogator being configured to determine if a collision occurred between devices that sent a reply and, if so, to create a new, smaller, specified group by descending in the tree; and, if not, to transmit a command at the same node.

36. A system in accordance with claim 35 wherein the unique identification numbers for respective devices are stored in digital form and respectively comprise a predetermined number of bits.

37. A system in accordance with claim 35 wherein the random values for respective devices are stored in digital form and respectively comprise a predetermined number of bits.

38. A system in accordance with claim 35 wherein the interrogator is configured to determine if a collision occurred between devices that sent a reply in response to respective Identify commands and, if so, to create further new specified groups and repeat the transmitting of the command requesting devices having random values within a specified group of random values to respond using different specified groups until all responding devices capable of responding are identified.--